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(54) Title: **APPARATUS FOR SORTING AND STACKING DISC-LIKE OBJECTS**

(57) Abstract

The present invention relates to an apparatus for sorting disc-like objects and stacking them according to identity in different stacks. It comprises a receptacle trough for receiving discs to be sorted. A circular rotatable carrier is provided with a plurality of receiving spaces for separate discs to move them from a lower level to a higher level past means for recognizing the identity of each disc. A series of drop channels is arranged at the higher level and is provided with means for opening and closing the channel openings to let a selected one of the discs drop under the influence of gravity down one of the channels. The apparatus is provided with means for transferring each disc laterally from the lower end of the channel to the bottom of an upright disc-stack magazine, and means for elevating the stack from a lower to a higher level within the magazine.

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TITLE

Apparatus for sorting and stacking disc-like objects

FIELD OF THE INVENTION

5 The present invention relates to an apparatus for sorting disc-like objects, e.g. roulette chips, and stacking them according to identity in different stacks. The unsorted discs are dumped into a receptacle trough. A circular rotatable carrier with a plurality of receiving spaces
10 for separate discs is rotated to move said separate discs from a low level to a higher level, wherein they are moved past means for recognizing the identity of each disc. A series of drop channels is provided with means for opening and closing the channel openings to let a
15 selected one of said discs drop under the influence of gravity down one of said channels.

BACKGROUND OF THE INVENTION

20 Machines are known which sort coins according to different parameters, e.g. size or weight. Many of these machines comprise the circular rotatable carrier, and the series of drop channels described above. Normally the sorted coins are counted and stacked in hollow tube containers at the bottom end of the drop channels. These
25 machines are not suitable for use in sorting and stacking marker chips which are sold to players, and, after use as markers, are sorted, stacked, and recirculated at a roulette table.

30 US Patent 4,157,139 relates to a machine for sorting of discs, e.g. roulette chips, wherein a special conveyor chain is used for moving the marker chips in single file along a sorting track. After colour identification, the chips are moved past a series of receiving spaces each
35 arranged to receive a stack of chips. Transfer means are operable to transfer selected chips from the conveyor to

the lowermost positions in stacks of chips at the spaces. The newly sorted discs are entered at the bottom.

One problem with the machine according to US Patent 4,157,139 is that the capacity is limited because the chips have a serial flow along the series of receiving spaces. Another problem is that the chips are not stored at the same level in the receiving spaces, i.e. the level depends upon how fast each marker colour is picked up and sorted. Thus there will often be a delay before the croupier can deliver won chips if there are many chips in circulation at the same time at the gambling table. It is common for the croupier to bend forward to reach down into the receiving spaces in order to be able to pick up a predetermined number of chips. This repeated bending is ergonomically unsound, considering the normal eight working hours for a croupier.

TECHNICAL PROBLEM

One of the objects of this invention is to provide a sorting and stacking apparatus which is more efficient than the prior art machines. Another object of the invention is to make the marker chips available to the croupier at a certain ergonomically suitable level at the gambling table top, so that the croupier will not have to bend his back to withdraw marker chips.

SOLUTION AND ADVANTAGES

The apparatus according to the invention is characterized by means for transferring each disc laterally from the lower end of said channel to the bottom of an upright disc-stack magazine, and means for elevating said stack from a lower to a higher level within said magazine.

This solution allows for much more freedom of design, so that a substantial capacity increase is possible. Also,

the elevating means insures that there always are marker chips available for withdrawal at the table top.

BRIEF DESCRIPTION OF DRAWINGS

- 5 The invention shall be further described in the following with reference to the attached drawings in which
- Fig. 1 shows in a schematic manner the invention in a side view,
- 10 Fig. 2 is a perspective view of the invention showing the rotatable carrier, the identity recorder, and the sorting track,
- Fig. 3 is a side view of the sorting track and the top of one drop channel,
- 15 Fig. 4 is a schematic perspective view illustrating the drive mechanism for the lateral transfer means and the elevating means,
- Fig. 5 is a side view of said transfer and elevating means,
- Fig. 6 shows said means in an elevated view, and
- 20 Fig. 7 shows said means in an end view.

DESCRIPTION OF PREFERRED EMBODIMENTS

- 25 The illustrated sorting and stacking apparatus is intended for use with roulette marker chips at a roulette table. These chips are in the form of flat circular discs which differ from one another only in respect of the colour. Thus, the identities are here represented by their different colours.

- 30 In Fig. 1 there is accordingly shown a sorting and stacking apparatus 10 which is mounted on a chassis 11 having a set of wheels 12. The top surface 13 of the apparatus 10 is level with the table top 14 of a roulette table.

- 35 At the right side of the apparatus as it is shown in Fig. 1, a trough 15 is provided into which unsorted marker

chips 16 are dumped through an opening in the table top 14. A rotatable circular carrier 17 presents an inclined surface which reaches into the bottom of the trough 15. An electric motor 18 is provided for rotation of the carrier 17 via an angle gear drive 19. The carrier 17 has a plurality of disc-shaped spaces 20 arranged along the brim (see also Fig. 2). The chips 16 tend to slide down the surfaces of the trough and the carrier 17, until they can drop into any of the passing disc-shaped spaces 20. Thus, each one of the disc-shaped spaces 20 will be able to carry a single marker chip 16 up from the bottom of the trough 15.

Near the top of the inclined surface formed by the carrier 17, an identity recorder 21 is mounted so that the disc-shaped spaces 20 have to pass below it during rotation of the carrier 17. The identity recorder 21 is adapted to record the identity, i.e. the colour of each chip. The details of the identity recorder 21 are not the subject of this invention and, for example, the means for micro-processor controlled colour scanning is available to the man in this field. A number of drop mechanisms 22, e.g. ten, is arranged along the top of the inclined carrier 17. The drop mechanisms 22 are controlled by the identity recorder so that each drop mechanism will only open for a certain marker colour. A corresponding number of drop channels 23 is arranged below the series of drop mechanisms 22.

Each drop channel 23 leads down to a lateral transfer mechanism 24 which comprises an endless belt drive 24a running over two belt drive rollers 24b, 24c. The lateral transfer mechanism 24 is adapted to enter marker chips 16 into the bottom of a vertical chip magazine 25. At the top of each magazine 25, above the top surface 13, a sensor 26 is mounted so that it can sense the presence of a

certain number of marker chips in the stack 16a above the level of the surface 13.

Fig. 2 illustrates the counter-clockwise rotation of the carrier 17 making the chips pass the identity recorder 21 before they reach the series of drop mechanisms. An agitator 27 is adapted to disturb the chips 16 in the trough 15, so that the chips are prevented from getting stuck in the trough. Fig. 2 shows only one sensor 26, for the sake of clarity, but openings 13a indicate the location of the remaining magazines.

Fig. 3 shows a supporting plate 28 for the carrier 17. This plate 28 is provided with an opening 28a before each of the drop mechanisms 22. Each mechanism 22 for transferring selected chips 16 from the spaces 20 in the carrier 17 to one of the drop channels 23 comprises a pivotally hinged finger 29 which has a pivot point at 30. The finger 29 is controlled by a solenoid 31, so that it can swing away from a rest position shown with broken lines in Fig. 3, in which position it forms a continuation of the surface of the plate 28 and blocks the opening 28a, to an open position shown with full lines in Fig. 3, letting the chip drop through the opening 28a.

Fig. 4 schematically illustrates the drive mechanism for the lateral transfer means and the vertical elevating means which will be described later. The drive shaft of an electric drive motor 32 is connected to an angle gearbox 33 which, via a belt drive 34, drives a first drive shaft 35. The drive shaft 35 is connected via gears 36, 37 to a countershaft 38. The countershaft 38 drives a second drive shaft 39 via a belt drive 40. Thus, the first and second drive shafts are constantly driven in opposite directions. Each of said drive shafts 35, 39 is provided with a friction coupling 41 and 42 respectively.

The couplings 41, 42 are connected to the rollers of a belt drive 43. This belt drive 43 can be made to stand still or to move in either direction by control of the couplings 41, 42. For this purpose, the couplings are
5 remotely controlled via solenoids and levers (not shown in the drawings) so that either or none of the couplings is engaged with the two counter-rotating shafts 35, 39.

The belt drive 43 is attached to an elevator holder 44 which, by the action of the belt, can be made to move
10 vertically along the marker chip magazine 25. The sizes of the gears 36, 37 govern the speed of rotation of the second shaft, so that the elevator holder 44 will move downwards at a greater speed than in the other direction.

The first drive shaft 35 is also connected via a belt drive 45 and a shaft 46 to drive the lateral transfer
15 mechanism 24 via its roller 24b.

Figs. 5-7 show the lateral transfer mechanism 24 and the elevator more clearly. The drop channel 23 leads down between two side walls 47, together forming a channel 48 which is only slightly wider than the marker chip diameter and leads towards the bottom of the magazine 25. The
20 endless belt drive 24a is arranged at the centre of the channel 48, and the belt is driven with the upper limb towards the magazine. Knobs 49 are attached to the belt so that they protrude outward at equal distances from the belt to drive the separate chips in the channel 48
25 towards the magazine 25.

An entering element 50 is placed at the end of the channel 48 and below the magazine 25. The entering element comprises an inclined surface 50a which is followed by a
35 flat surface 50b perpendicular to the longitudinal axis of the magazine 25. As Fig. 5 shows, the leading portion

of the marker chip will be driven up along the inclined surface 50a until it touches the underside of the lowermost one of the earlier inserted chips causing the stack of chips already accommodated in the magazine to be lifted. A central slot 50c (see Fig. 6) in the entering
5 element allows the knobs 49 to pass through the element after pushing the chip onto said element. The last entered chip will now rest horizontally upon the surface 50b at the bottom of the magazine.

10

The magazine 25 comprises two diametrically opposed vertical wall elements 51 having concave opposite surfaces which together define a circular magazine channel leading up to the top surface 13. There is room for about 40
15 chips at the bottom of the magazine. Above that level, the concave surfaces have a friction coating 52 in the form of 1-2 mm long synthetic fibres. These fibres have been attached to the concave wall surfaces by an electrostatic method in which an adhesive has first been applied
20 to the surfaces, and the fibres have been electrostatically charged so as to be attracted by a magnetic field to the adhesive surface. The result is a velvet-like surface with fibres generally perpendicular to the longitudinal axis of the magazine. The friction surface
25 cooperates with the chips to hold them stationary in the magazine against the force of gravity.

30

The elevator holder 44 is adapted to elevate the stack from a lower to a higher level within the magazine 25 and comprises two fingers 53 which are pivotally hinged at 54. The holder 44 comprises an upper and a lower member 44a and 44b respectively of which the upper member 44a is connected to the belt drive 43. Both members 44a, 44b are slidingly journaled upon a vertical guide rod 55. The
35 upper member 44a can slide along the rod 55 without any substantial friction. The lower member 44b slides along

the rod 55 with a certain friction. The upper member and the lower member are interconnected via arms 56, cams 57 and cam openings 58 in the pivotally hinged fingers 53. A relative movement between the upper and lower holder members will result in synchronous pivoting of the fingers 53. This happens when the belt drive 43 pulls the upper holder. When the upper holder is pulled away from the lower holder, which happens when the belt moves upwards along the magazine, the lower holder acts by means of the friction resistance via the arms 56, the cams 57 and the cam openings 58 to pull the finger tips together as shown in Figs. 6 and 7. Now both fingertips will engage the underside of the bottom chip in the magazine 25 via the openings between the two wall elements 51, and move the entire stack present above the entering element 50 upwards. The elevating of the stack will continue until the sensor 26 senses the presence of marker chips at the table top 13. Then the belt drive 43 will reverse its motion and the upper holder 44a will be pulled towards the lower holder 44b. Thus the arms 56 and the cams 57 will push the fingers 53 apart, so that the elevating mechanism can travel down to its rest position below the entering element 50b, see Figs. 5, 7, without interfering the chips which in the meantime have been entered at the bottom of the magazine.

For the sake of clarity, the drawings only show one set of lateral transfer means 24, one magazine 25 and one set of elevating means 44. In the completed apparatus, the shaft 46 will be long enough to support and drive ten parallel belt drives 24, and the shafts 35, 39 will be long enough to support and control ten sets of friction couplings 41, 42 and belt drives 43. Naturally, the ten belt drives 43 will be individually controlled, e.g. via central micro-processor (not shown in the drawings) which uses the identity recorder 21 for sensing the number of

discs 16 passing through each of the parallel drop channels 23, and the sensors 26 for sensing the presence of discs at the top 13 of the magazine channels.

5 The electric wire system needed for the operation and control of the above described apparatus should not need a detailed description since it is not the subject of this invention and certainly is available to the man in this field.

10

The illustrated and described apparatus is only an exemplary embodiment, and many other embodiments fall within the scope of the invention. For example the lateral transfer mechanism or the elevator mechanism may use
15 other means than those shown in the drawings. Also, other drive means may be used for the different shafts.

Claims

1. Apparatus for sorting disc-like objects (16) and stacking them according to identity in different stacks, comprising a receptacle trough (15) for receiving discs (16) to be sorted, a circular rotatable carrier (17) with a plurality of receiving spaces for separate discs, means (18) for rotating said carrier (17) to move said separate discs from a low level to a higher level past means (21) for recognizing the identity of each disc, and a series of drop channels (23) being provided with means for opening and closing the channel openings to let a selected one of said discs drop under the influence of gravity down one of said channels (23),
- characterized by means (24) for transferring each disc (16) laterally from the lower end of said channel (23) to the bottom of an upright disc-stack magazine (25), and means (44) for elevating said stack from a lower to a higher level within said magazine (25).
2. Apparatus according to claim 1, characterized in that the lateral transfer means (24) comprise partly inclined entering element means (50) located at the bottom of the magazine (25), for guiding the disc (16) into said magazine below a previously stacked disc.
3. Apparatus according to claim 2, characterized in that the entering element means (50) comprise an inclined surface (50a) which is followed by a flat surface (50b) perpendicular to the longitudinal axis of the magazine (25).
4. Apparatus according to claim 2, characterized in that the lateral transfer means (24) comprise an endless conveyor (24a) extending over two

parallel, horizontal shafts, one of which being connected to means (46) for driving the belt (24a) in the direction wherein the upper belt limb moves towards the stack of discs, a plurality of latch means (49) arranged at equal
5 distances along said belt so that they protrude outward to act against the edge of the disc (16), and surface forming means (47, 48) to guide each disc during its lateral movement.

10 5. Apparatus according to claim 4, c h a r a c -
t e r i z e d in that the entering element means (50) is provided with a central slot (50c) allowing the belt latch means (49) to pass through said entering element means (50) after pushing the disc (16) along the element
15 surfaces (50a, 50b).

6. Apparatus according to claim 1, c h a r a c -
t e r i z e d in that the magazine (25) comprises at least two vertical wall elements (51) having concave
20 opposite surfaces together defining a circular channel, said concave surfaces having a friction coating (52) adapted to cooperate with stacked discs holding them to maintain their level in the channel.

25 7. Apparatus according to claim 6, c h a r a c -
t e r i z e d in that the means (44) for elevating the stack from a lower to a higher level within the magazine (25) comprise means (53) for engaging the underside of the lowest disc (16) in the stack in an upward movement,
30 and means for moving said engaging means (53) to and fro along said channel.

8. Apparatus according to claim 7,
c h a r a c t e r i z e d in that the means (44) for
35 elevating the stack from a lower to a higher level within the magazine (25) comprise two pivotally hinged fingers

(53) with means (56-58) for synchronous pivoting of said fingers so that their tips can be moved in or out of the disc channel, and means (44a, 44b) for governing the fingers so that their tips reach into the channel when moving up along said channel, and are released from the channel when moving down along said channel.

9. Apparatus according to claim 8,
c h a r a c t e r i z e d in that the elevator fingers (53) are mounted on a holder (44) which is slidably journaled upon a guide rod (55).

10. Apparatus according to claim 9,
c h a r a c t e r i z e d in that the holder (44) is connected to an endless vertically arranged conveyor (43) extending over two parallel, horizontal shafts (35, 39) provided with means (41, 42) for driving said conveyor (43) in both directions of travel.

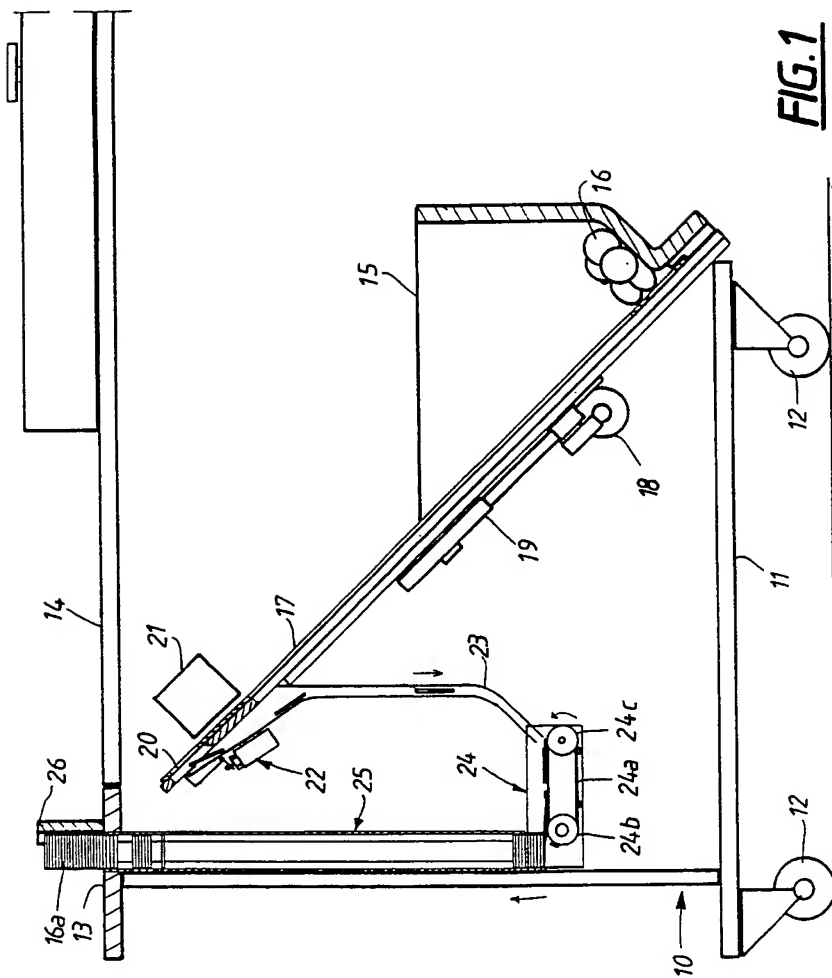
11. Apparatus according to claim 10,
c h a r a c t e r i z e d in that the conveyor (43) is connected to each shaft (35, 39) via a friction coupling (41, 42), that the shafts are continuously driven in opposite directions, and that means for controlling the couplings are arranged so that the finger holder can be made to move along the magazine (25), to stop at any desired magazine level, and to return to a waiting position below the magazine.

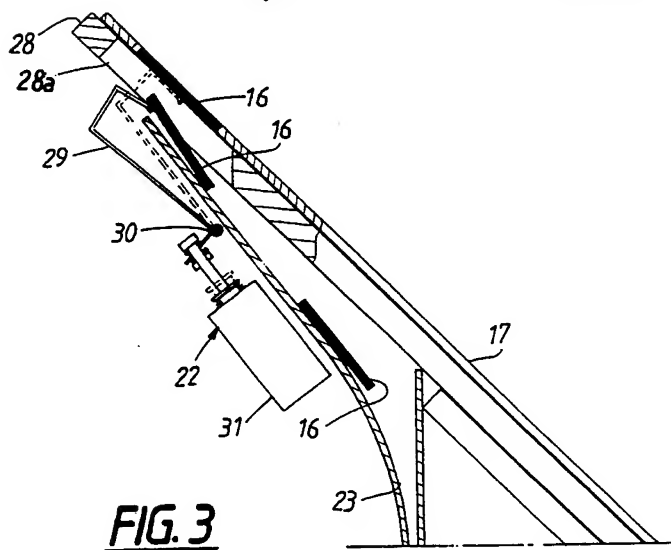
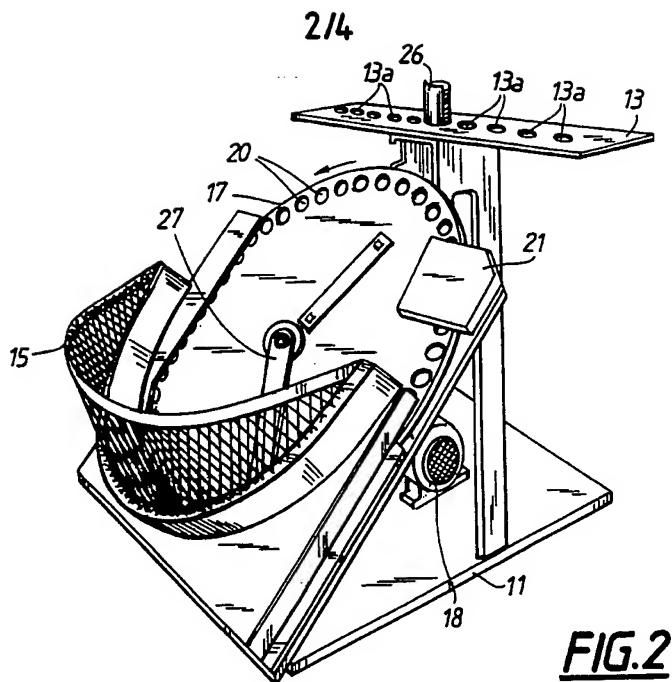
12. Apparatus according to claim 11,
c h a r a c t e r i z e d in that the motion of the vertical conveyor (43) is controlled by a micro-processor which comprises means (21) for sensing the number of discs (16) passing through each of the parallel drop channels (23), and means (26) for sensing the presence of discs at the top (13) of each magazine channel.

13

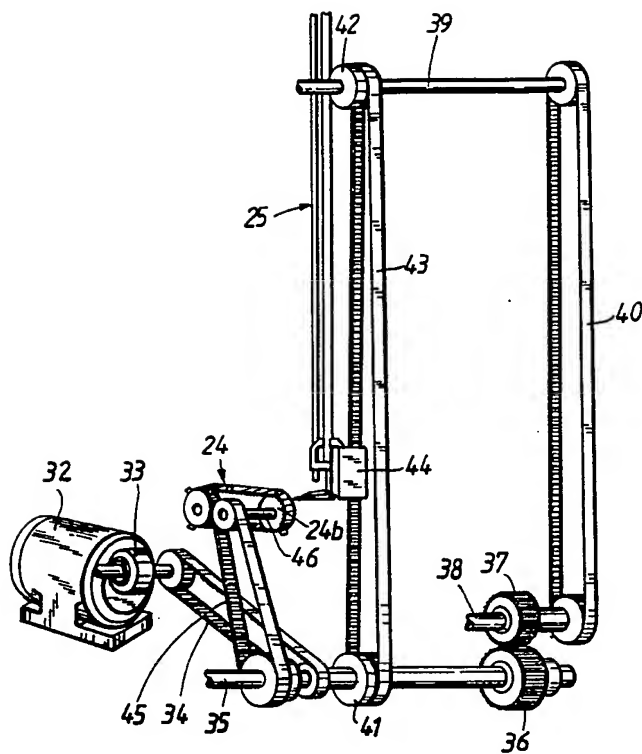
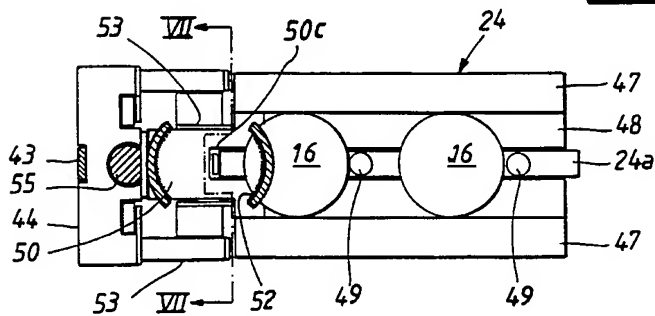
13. Apparatus according to claim 6,
c h a r a c t e r i z e d in that the friction coating
(52) comprises 1-2 mm long synthetic fibres attached by
an adhesive to the concave wall surfaces in such a way
5 that their longitudinal axis is generally perpendicular
to the longitudinal axis of the magazine (25).

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FIG. 4FIG. 6

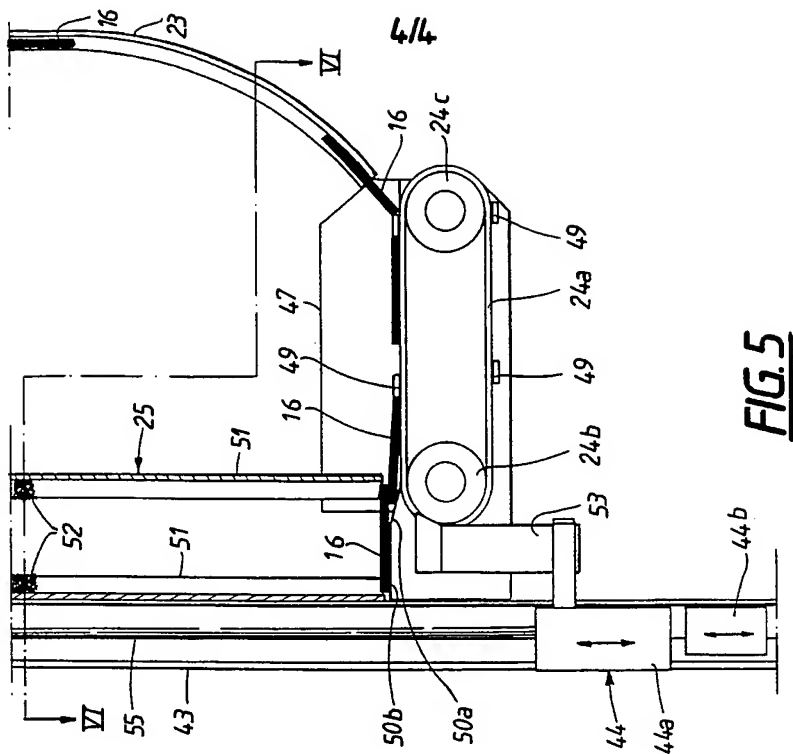


FIG. 5

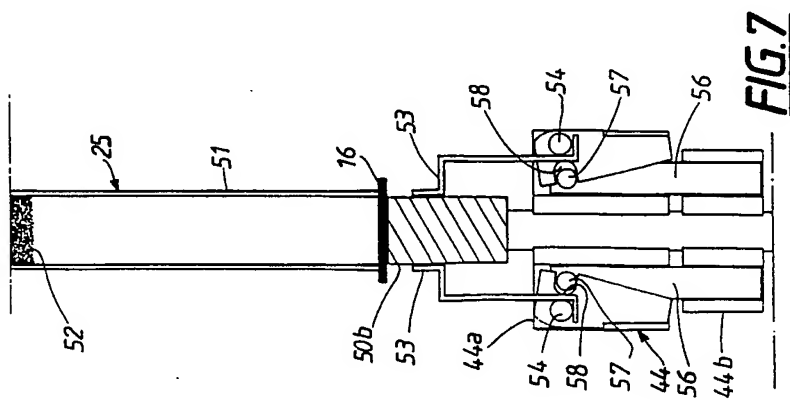


FIG. 7

INTERNATIONAL SEARCH REPORT

International Application No PCT/SE 90/00880

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) ⁶ According to International Patent Classification (IPC) or to both National Classification and IPC IPC5: B 07 C 5/00, G 07 D 3/00						
II. FIELDS SEARCHED <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black;">Minimum Documentation Searched⁷</div> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 20%; border-bottom: 1px solid black; padding: 2px;">Classification System</td> <td style="border-bottom: 1px solid black; padding: 2px;">Classification Symbols</td> </tr> <tr> <td style="padding: 5px;">IPC5</td> <td style="padding: 5px;">B 07 C, G 07 D</td> </tr> </table> <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black;">Documentation Searched other than Minimum Documentation to the extent that such documents are included in Fields Searched⁸</div>			Classification System	Classification Symbols	IPC5	B 07 C, G 07 D
Classification System	Classification Symbols					
IPC5	B 07 C, G 07 D					
SE,DK,FI,NO classes as above						
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹						
Category *	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³				
Y	US, A, 4059122 (Y. KINOSHITA) 22 November 1977, see abstract <div style="text-align: center;">--</div>	1-3,7				
Y	SE, B, 463700 (E. SJÖSTRÖM) 24 May 1990, see page 4, line 7 - page 5, line 31; figures 6-8 <div style="text-align: center;">--</div>	1-3,7				
A	US, A, 4902263 (T. ITO ET AL) 20 February 1990, see abstract <div style="text-align: center;">--</div>	1				
A	US, A, 4820237 (T. SHINOZAKI ET AL) 11 April 1989, see column 1, line 11 - line 48; figures 4,5 <div style="text-align: center;">-- -----</div>	10				
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IV. CERTIFICATION						
Date of the Actual Completion of the International Search 3rd June 1991	Date of Mailing of this International Search Report 1991 -07- 2 5					
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**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO. PCT/SE 90/00880**

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
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Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US-A- 4059122	77-11-22	JP-A-	49105736	74-10-07
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		JP-A-	1003791	89-01-09
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		JP-A-	62188353	87-08-17

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